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ABSTRACT

This paper has three objectives: (1) to examine the context in which faculty developers operate; (2) to review 25-year program of research for the findings that are most pertinent to teacher developers; and (3) to situate research into teacher development and consider the strategies that might persuade others to conduct research into teacher development in postsecondary education. The paper begins with an investigation of the structure of knowledge in university courses and moved through studies of the expectations of learning held by professors and students in selected disciplines. The results of the program of investigations over the years fall into three nested categories. At the most general level are findings about methods and lines of convergence across institutions and disciplines. At a more specific level is the examination of student learning and the comparisons between different types of student experience. Nested within these areas is the study of effects of differences in learning contexts. From this body of research, certain indicators of success for faculty developers have been derived. These are: (1) appropriate content in a course; (2) whether or not students have learned to think in a new way; and (3) the extent to which students incorporate their learning from courses into their other studies and their lives as scholars. A second set of indicators revolves around clear expectations for students and strategies for learning. A third set of indicators is needed to guide the research of faculty developers, and to explain instructional goals and methods and the extent to which they can be transferred. (Contains 2 tables, 2 figures and 29 references.) (SLD).

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Indicators of success: From concepts to classrooms

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The W. J. McKeachie Career Achievement Award address to the Faculty Evaluation and Development Group of the American Educational Research Association, 25 April 2000, New Orleans

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As faculty developers we find ourselves called upon to fulfill a variety of roles – orienting new faculty, guide, evaluator, researcher, empathizer. These roles are carried out in institutions that often provide minimal structure, so that we are also explorers – testers of deep water, with *Teaching Tips* (McKeachie, 1999) as our scripture. How can we know when we have been successful?

I have three objectives in this address. The first is to examine the context in which we as faculty developers operate. This is important because if we are to be effective as faculty developers, we need to understand the conditions that frame our work, and the limits and possibilities that these conditions oblige. Identifying the context is the first defining characteristic of expertise, a proviso for knowing ourselves (Donald, 1992). The second objective is to examine my twenty-five year program of research for those findings that are most pertinent to our metier as faculty developers. The third objective originates in our reform legacy as psychologists and educators; it is to situate where we might be going and what strategies we might use to persuade others to accompany us. Each objective has a particular relation to indicators of success in postsecondary education.

The context in which we operate

Universities and colleges have a range of purposes and organizational characteristics, but have certain attributes in common that determine what we can accomplish as faculty developers. The attributes include both goals and limitations. One goal is axiomatic to our discussion: the ultimate outcome of instructional practice is effective student learning. Over the years I have become increasingly aware that the faculty evaluation process we have developed in our universities focuses attention on an important part of the student learning experience, but does not take into account other factors that have major effects on student learning. These factors , frequently ignored, have major and at times insidious effects on what and how students learn. One factor is the diffuseness and complexity of the educational environment in a

postsecondary institution. Another is the variety of knowledge bases, skills, attitudes, and epistemologies our students bring to the learning milieu. A third is the longstanding assumption that students learn by attending lectures in large groups; this pervasive assumption has led decision makers in the institution to ignore the learning process. These factors are limiting conditions for faculty development and pedagogical improvement. Their effects are shown in the following practices.

First, it has been common practice to evaluate the learning experience of our students classroom by classroom. The learning environment of our students, however, consists of the entire campus, and with the advent of the internet, increasingly extends beyond campus. This means that learning experiences are increasingly variable. On campus, students will spend less than three hours per week in any given classroom, and other venues such as the library, laboratory, cafeteria, work or field placements, or the student's own room acquire greater importance as learning settings. Undergraduate students report that their learning takes place when they do their assignments, not in the classroom (Donald & Denison, 1997). The point of contact for pedagogical improvement is therefore difficult to find. Considering the limited time students spend in classrooms, evaluating what has happened in a classroom may capture at most the lion's whisker.

In our evaluation of instruction, we ask our students to provide indices of their satisfaction with their learning situation. Increasingly, we factor into the analysis some measure of their background and their achievement. But we are not proactive in establishing their needs and the appropriate learning situations to respond to them; needs assessments at the beginning of courses are rare. We have also neglected to measure students' insight into their responsibility for learning and their preparation for independent learning. We do not tend, for example, to have a contract for learning that spells out the obligations of all parties. In my institution, the students have a contract with the university, and professors have a contract with the university, but professors

and students do not have a contract with each other, nor do programs have contracts. The terms of instruction and learning outcomes not stated.

The effect of these missing links is exacerbated by the fact that students are frequently newly independent and testing their independence from family and home town constraints. Added to the equation, students often lack the strategies needed for independent learning, so their own desired independence may work against success in learning. I have argued elsewhere (Donald, 2000) that this problem requires a set of strategies on the part of instructors to enlighten students on their role as independent learners. The largest contributor to student learning gains at the postsecondary level is the quality of effort students put into their work (Pace, 1988). To date, however, institutions have not been highly successful in getting across this message. On the contrary, students who have been enculturated to be consumers, extend this role in relation to the university, which relieves them of the responsibility for learning.

Given these limitations, the institution places instructors and us as faculty developers in a dilemma of major proportions – instructors are evaluated for learning situations over which they have relatively little control, by undergraduates who may lack a clear understanding of what their responsibilities as learners are. In response to this situation, I have suggested that individual professors can take certain steps, for example, by explaining educational goals, supplying an overview of their discipline, and clarifying to students that their learning will depend primarily upon the quality of effort they put into their work (Donald, 2000). But I think our role as faculty developers places the onus on us to determine in what ways we can improve the match between student learning and accountability for that learning. What has my research as a faculty developer told me?

Research on learning in the university

A major impetus for my research has come from the sociopolitical level of discourse, where the focal issues have been the quality and evaluation of teaching,

(Donald, 1991a; 1996; Donald & Denison, 1996; Donald, Saroyan & Denison, 1995). The foundation for my research agenda, however, is higher order learning, how we help postsecondary students to think. In order to answer the questions that intrigued me about postsecondary teaching and learning, I have analyzed professors' knowledge structures and students' developing cognitive structures, and have traversed a route from discipline and paradigm to the university classroom. The underlying motivation in my program of research has been the hunt for explanatory principles of potential use within the field of higher education.

Cognitive structure

I began my research into learning in the university in 1977 with a research grant to examine the structure of knowledge in university courses as a means for understanding course development and the evaluation of student learning. The research process involved working with professors on courses they had developed to understand how the most important concepts in the courses were related. A concept was defined for this purpose as a unit of thought - an element of knowledge that enables us to organize experience (Donald, 1983). The concepts relevant to the 16 courses studied ranged from 33 in the philosophy course to 170 in physical chemistry, with an average of 99 relevant concepts per course. From this set of concepts, the professors selected the main or linking concepts in the course, such as *biological system* and *analysis of data* in the microbiology course (Figure 1).

Among the methods used to determine the relations between key concepts, the most useful method according to the professors was a tree structure or concept map which linked the most closely related concepts in order, so that link 1 was the closest link (Shavelson & Stanton, 1975). Figure 1 shows the hierarchical organization of the methods used in the microbiology course, with the most important concept, *analysis of data*, at the top, leading to a web of substantive concepts organized around *biological system*. In this laboratory course, the majority of concept relationships were causal or

procedural, that is, one concept caused or preceded the concept to which it was linked, suggesting a highly structured pattern of learning. Figure 2, from a n introductory law course on tort or wrongdoing, shows a series of factors such as *risk* that are subcategories of *liability for fault*, and that will in turn affect the *recovery of damages*. Each of these concepts (*intentional tort* to *vicarious liability*) has a logical or conditional relationship with *recovery of damages*.

What did we learn from this research? First, the variety in kinds and numbers of concepts in a course suggested a wide difference in what students are expected to learn for the same credit. Second, in some disciplines, there are clear and well defined knowledge structures in which the concepts have essential ways of relating to each other. Other disciplines are less well structured (Frederiksen, 1984), and have looser organizations in which the major concepts are related more frequently on the basis of similarity than causation or logic. The implications for learning are that in some disciplines, the logic of the knowledge structure will control learning, while in others, students will have to seek a schema in a swamp. This would require very different approaches on the part of the learners (Donald, 1986; 1987). Given these results (Principles 1 and 2), the next step was to test learning and the development of students' cognitive structures in this same set of courses.

1. The learning task varies substantially across courses; courses are not equivalent.
2. Some courses have well defined and logically based knowledge structures which constitute the learning task. In other courses, knowledge structures based on similarity require a different form of learning.

Students' cognitive structures

During the next three years, we studied the comparative effects of student background variables and entering knowledge on student learning and achievement in the same 16 courses. At the beginning of the year I went to each class, and asked

students to define the set of key concepts for their course, and to provide information about their background preparation for the course. A research assistant attended classes and recorded the use of key concepts in class. At the end of the course, students were again asked to define the key concepts, and to do a tree structure of the key concepts.

In the microbiology course, the professor had added four key concepts – *recombination, deletion and complementation mapping, conjugation, restriction enzyme mapping*, and *restriction-modification systems*. Although students knew least about the four recently introduced concepts at the beginning of the course, by the end of the semester they had made the greatest gains in knowledge of them. Student biology background was the strongest predictor of course achievement rather than general ability or specific knowledge of concepts. The study of this course showed that key concepts are frequently processes, that there is a need to update the knowledge structure within a brief period, and that background in the field is an important predictor of course achievement.

In the law course, *damage* was the concept most frequently mentioned in class, but *unintentional tort* was the best known at the end of the course, with a very high understanding of the concept shown by the students. Students' overall average the previous year had the highest correlation (.50) with final grade in the course, suggesting an ability effect, but their LSAT scores did not correlate significantly with grade. Students made the greatest gains in concept knowledge in this course compared with the other 15 courses. As most students in the course were in their first year of university and this was their first law course, their knowledge of the concepts was relatively low at the beginning of the course, and they showed a 33% gain in knowledge of key concepts.

Overall there were several important findings from this set of studies (Principles 3 and 4). One was that although students gained knowledge of the key concepts during

the course, on the whole they did not gain a great deal (on average 18%), and they left the course with at best a 67% knowledge of the most important concepts in the course. Knowledge of key concepts at the beginning of the course best predicted success in courses in the social sciences, but average the previous year tended to be the best predictor in the sciences, humanities and law. One explanation is that in the social sciences, students are learning a new vocabulary, so the course vocabulary will be a more important indicator than general ability.

3. Overall, students do not acquire a precise knowledge of the most important concepts in their courses.
4. In the sciences and humanities, previous achievement is a stronger predictor of achievement in a course than knowledge of key concepts in the course; in the social sciences, concept knowledge is a better predictor.

These findings prompted two studies, one on different ways to portray knowledge structures, and the other on the acquisition of intellectual skills in postsecondary education.

The portrayal of knowledge structures

The main goal in this study was to determine the relative sensitivity of different portrayal techniques for representing knowledge structures within a course. We chose the law course from the previous studies, since the concepts showed a pattern of both hierarchical and logical relationships, important for potential generalization to other courses, and students had shown the greatest gain in concept knowledge. We selected a larger unit of analysis, the proposition, defined as "a statement which expresses relationships among concepts and which has a truth value", for comparison with the concept as a means of representing course material. We analyzed all course material to obtain 182 important propositions of which 73 were most important according to the

professor. We asked other experts (law professors who also taught tort) to rate the importance of the propositions for a course on tort. Students from the class were also interviewed to determine which propositions they considered important.

Analysis of the relationship between the most frequently found concepts in the propositions with the 11 key concepts from the previous study showed that concepts in the propositions were subcategories of the key concepts, for example, *apportionment of damages* was a subcategory of *recovery of damages* (Donald & Nagy, 1985). The two other experts in the field agreed with the overall choice of the most important propositions of the professor teaching the course. Twenty-five propositions were agreed upon by all three professors as being important; these tended to be fundamental principles or definitions (14) which employed basic concepts and were more concrete. Disagreement arose when propositions were abstract, general or conditional. Students tended to choose the most familiar and specific propositions as important. What did we learn from this study?

5. Within a discipline, agreement on the importance of basic knowledge structures, that is, propositions in an entry level course to the discipline, is greatest for fundamental principles or definitions.

6. Students choose the familiar and specific as important in their courses.

Intellectual skills in higher education

The impetus for the study of intellectual skills was a discussion with the physics professor who participated in the study on course concepts. When I asked him why he thought student ability rather than concept knowledge was the best predictor of achievement in his course, he replied that it was because he was not teaching concepts, but rather how to analyze and synthesize. The study was designed to test models of skill acquisition, and to develop a comprehensive model of the intellectual

skills necessary for expertise in different disciplines. The first step was to examine the intellectual skills used at the postsecondary level as reported in research on critical thinking, problem solving, formal operations and creativity (Donald, 1985). Some 80 operations or complex behaviors were identified, sorted and categorized by a set of experts in the field of postsecondary teaching and learning, to produce a working model of 30 thinking processes (Table 1) (Donald, 1992). Note that the thinking processes defining expertise include identifying the context, choosing relevant information, inference and verification. Critical thinking, in contrast, involves identifying assumptions, then inference and verification. All approaches to thinking processes involve verification.

We interviewed professors across disciplines to ascertain to what extent students could be expected to have already acquired these skills, what skills were developed in the course, which evaluated, which skills the professor used and which were considered most important for students to acquire. Although there is a general tendency to think of biological science courses as being knowledge-laden and descriptive in nature, the biology course selected for study emphasized the development of thinking processes. In it, students are expected to *identify the context*, considered by the professor to be very important if extrapolations are to be successful (Table 2). Successful learning involves progress through alternating patterns of deductive and inductive thinking, with the use of inferential skills, particularly *changing perspective*. The professor pointed out that unless students understand the processes behind the derivation of biological knowledge, they cannot understand the limits of knowledge. He therefore gives them questions to be answered in their reports that require creative inference. In biology, inference and verification skills distinguish the expert from the novice. The final outcome is insight into how biological information is derived. Thus the focus is on knowledge, but from the perspective of its creation and limits, a powerful tool in any discipline.

Table 1. Working model of thinking processes in higher education

DESCRIPTION (PS, SM)	Delineation or definition of a situation or form of a thing
identify context (E)	Establish surrounding environment to create a total picture
state conditions	State essential parts, prerequisites or requirements
state facts	State known information, events that have occurred
state functions	State normal or proper activity of a thing or specific duties
state assumptions (CT)	State suppositions, postulates or propositions assumed
state goal	State the ends, aims, objectives
SELECTION (PS)	Choice in preference to another or others
choose relevant information (E)	Select information that is pertinent to the issue in question
order information in importance	Rank, arrange in importance or according to its significance
identify critical elements	Determine units, parts, components which are important
identify critical relations	Determine connections between things which are important
REPRESENTATION (PS)	Depiction or portrayal through enactive, iconic or symbolic means
recognize organizing principles	Identify laws, methods, rules which arrange in systematic whole
organize elements and relations	Arrange parts, connections between things into systematic whole
illustrate elements and relations	Make clear by examples, the parts, connections between things
modify elements and relations	Change, alter or qualify the parts, connections between things
INFERENCE (E, H, CT, PS)	Act or process of drawing conclusions from premises or evidence
discover new relations between elements	Detect or expose connections between parts, units, components
discover new relations between relations	Detect or expose connections between connections of things
discover equivalences	Detect or expose equality in value, force or significance
categorize	Classify, arrange into parts
order	Rank, sequence, arrange methodically
change perspective	Alter view, vista, interrelations, significance of facts or info
hypothesize	Suppose or form a proposition as a basis for reasoning
SYNTHESIS (PS)	Composition of parts or elements into a complex whole
combine parts to form a whole	Join, associate elements, components into a system or pattern
elaborate	Work out, complete with great detail, exactness or complexity
generate missing links	Produce or create what is lacking in a sequence; fill in the gap
develop course of action	Work out or expand the path, route or direction to be taken
VERIFICATION (E, H, CT, PS, SM)	Confirmation of accuracy, coherence, consistency, correspondence
compare alternative outcomes	Examine similarities or differences of results, consequences
compare outcome to standard	Examine similarities, differences of results to a criterion
judge validity	Critically examine the soundness, effectiveness by actual fact
use feedback	Employ results to regulate, adjust, adapt
confirm results	Establish or ratify conclusions, effects, outcomes or products

E: Expertise, H: Hermeneutics, CT: Critical Thinking, PS: Problem Solving, SM: Scientific Method

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Table 2. Professor's examples of thinking processes used in a biology course

DESCRIPTION Delineation or definition of a situation or form of a thing	- experts use to describe new and unfamiliar situations - data stated
identify context Establish surrounding environment to create a total picture	- very important if extrapolations are to be successful (inductive) -students have problems dealing with weights, measures and sampling
SELECTION Choice in preference to another or others	- all skills used in lab notebook - 2 to 3 page limit must be adhered to so students must select
REPRESENTATION Depiction or portrayal through enactive, iconic or symbolic means	- decisions on how best to convey information - used in lab notebook - charts, graphs, diagrams
INFERENCE Act or process of drawing conclusions from premises or evidence	- most important in inductive reasoning - distinguishes the expert from the novice thinker - course is first step toward advancement into expert level
discover relations between relations Detect or expose connections between connections of things	- ensured by questions to be answered in the final report - sample questions: What does each parameter tell you about this forest? How do the three parameters differ from one another in their biological impact?
discover equivalences Detect or expose equality in value, force or significance	- in the sampling lab, students are asked to make discoveries about a changing sample, and its relation to variability - sample question: Can you see other types of questions that might be answered with data or density, frequency or dominance?
categorize Classify, arrange into parts	- use sampling as a biological tool
order Rank, sequence, arrange methodically	- sample blood cells on a slide to do a differential count
change perspective Alter view, vista, interrelations, significance of facts or info	- most important in inductive reasoning at the expert level within a broader framework. Biology has major impacts on modern life. Unless students understand the processes behind the derivation of biological information, they cannot understand the limits of knowledge.
hypothesize Suppose or form a proposition as a basis for reasoning	- students are asked questions that demand that they hypothesize, predict, and discover, for example, What, if anything, can you predict about a canopy's forest composition in 200 years? - lab notebook is evaluated for new hypotheses
SYNTHESIS Composition of parts or elements into a complex whole	- experts apply biological information
VERIFICATION Confirmation of accuracy, coherence, consistency, correspondence	- ability to be critical of and to question results and conclusions - expert uses simultaneously with other processes; influences how other processes used (deductive thinking)

In the law course, the processes most focused were called *the methodology of legal judgment*: *recognizing organizing principles* (representation), *discovering new relations between elements* and *categorizing* (inference), *developing a course of action* (synthesis), and *verification*. The professor described the main goal of the course as developing students' ability to use the legal system which requires developing a high degree of analytical ability. The study produced the following general results.

7. A working model of thinking processes can be used across disciplines to determine the kinds of thinking processes developed in courses.

8. Inference and synthesis were most frequently used by professors to describe the kinds of processes developed in their courses, although different terms were used as blanket descriptions of the process.

Professors' expectations of students' ability to think

We next expanded our context to examine the expectations of learning held by professors and students in selected disciplines, including the knowledge, thinking processes, and attitudes expected to be acquired by students (Donald, 1988, 1990). We investigated students' perceptions as well as their professors'. Thirty-six professors were selected as model teachers and researchers from the University of Western Ontario, Cambridge University and Stanford University. They represented six matched pure and applied disciplines in the physical and social sciences and the humanities: physics, engineering, psychology, education, English literature and English language. This yielded a sample of six experts in each disciplinary area, interviewed individually in structured but open interviews.

One part of the study consisted of asking what their expectation of students' ability to think in their courses was; two-thirds replied that they expected their students to think logically and to reason with abstract propositions, more in the natural and social sciences

than in the humanities (Donald, 1988). Most defined logic in terms of an interrelation or sequence of facts or events seen as predictable, a definition of logical empiricism. An English professor explained that the analysis of text does not require a step by step logical pattern but rather the creation of a series of tentative hypotheses. Over half the professors expected their students to think independently, and just under half expected abstract thinking from their students. Overall, the social science professors had the greatest tendency to expect thinking abilities in their students, with natural science professors equally expectant in the areas of logical thinking and reasoning with abstract propositions, but less expectant about abstract thinking. The humanities professors had lower expectations of these abilities: they appeared to be looking for something other than logical thought from their students. The disciplinary groups most expectant of thinking abilities were the engineers, who focused on the development of problem solving skills in their program, but who were least interested in abstract thinking, and the educators and psychologists, who had a more general interest in all of the thinking abilities.

9. Logical thinking was expected of students in their courses by two-thirds of the professors (all in engineering and education).

10. Professors' expectations of their students' ability to think were greater in education, psychology and engineering than in other disciplines.

The student learning task

In the comparative study of student learning across disciplines, in 1990 a sample of professors from Monash University in Australia was added to those in Canada, the United Kingdom, and the United States. A class from each discipline in each university was observed, and students from the course were interviewed for their perceptions of what and how they learn in their courses. Their perceptions were then compared to their

professors'. Learning in three of the six disciplines - physics, engineering and psychology - is compared here.

The physics professors considered the learning task in physics to be difficult, primarily due to the sheer weight of the theory, but also because physics is often counterintuitive (Donald, 1993; 1994). The professors had a highly intellectual, content-oriented view of instruction: in class, emphasis was on covering course material. Direct teaching of problem solving skills did not tend to occur in class. Instead, it was the role of assignments, tutorials, or laboratories to develop these skills; in response to this situation, students commented that their learning took place in laboratories or supervisions rather than in the classroom. In contrast to their professors' view of learning as an intellectual exercise, students in introductory physics courses tended to think of learning in the course as a matter of acquiring knowledge. More advanced students also made the distinction between learning concepts in lectures and developing thinking processes through problem solving.

Professors' and students' views of the learning process in engineering were highly consistent, focusing on the problem solving process (Donald, 1991b; 1994). Professors were very student centered in their approach to instruction; they emphasized students' acquisition of learning strategies. In more advanced courses, design and communication skills were added to the repertoire. In response to their program, in their first year, engineering students talked about survival skills, including 'not doing all night sessions', 'checking solutions', or gaining perspective. In advanced courses, the instructional methods also had changed, with greater emphasis on discussion and greater opportunity to ask questions. Feeling less rather than more prepared for their courses than first and second year students, third and fourth year students were attuned to possible 'managerial' solutions, in which one reflects, then tries out a solution on a colleague, and if that has a good result, talks until 'something feasible comes out.'

Psychology professors took a third approach, that different courses supplied students with different intellectual skills (Donald, 1994). Instructional methods were varied, even within a course. Introductory courses were primarily vocabulary oriented, as students were entering a new field. Professors spoke more about graduate training than physics or engineering professors had, where apprenticeship and metacognitive skills became more important. Psychology students quickly recognized that they were learning to think, and gave examples such as writing up experiments, creating models, or learning how to think critically; these were learned through a combination of lectures, labs, specified reference material and discussion.

11. Disciplinary differences in emphasis on what is learned are reflected in instructional method and in students' attitudes toward the program.

12. If professors emphasize knowledge, students will approach the learning task as if it is one of acquiring knowledge; if thinking, students will interpret the task as learning to think.

Students' learning experience

The study of student learning across disciplines showed that professors and students could define the kinds of thinking developed in courses, but no study had been done of the way in which thinking processes were modeled or developed in class. In the next study, introductory level courses in the same disciplines were selected to be audited by a participant observer - a graduate research assistant who attended classes, labs, and conferences, and kept a record of class experiences. Lectures were audiotaped and a classroom observation matrix was used to examine the pedagogical strategies used, and the kind of thinking processes and learning strategies developed in each class.

The reports of the participant observers gave a perspective of learning in considerable contrast to those provided in interviews in the previous studies. From reading the log, for example, in the introductory psychology class, it became clear that students without a background in science tended to ignore scientific concepts instead of spending more time on them. The students' social life was paramount, and many students appeared to discover the need to think only after receiving midterm results. Overall, study of the classroom experience revealed that students, although prepared in terms of subject matter background, lacked the strategies to take maximum advantage of the university learning situation. This phenomenon suggests an explanation for the relatively low (18%) increase in concept knowledge across courses.

13. The perspective of learning offered by participant observation in courses was broader than that offered by interview and visitation, and identified the important role of student life in the classroom.

14. Learning strategies were underdeveloped in many students in introductory classes, although students appeared to be prepared in terms of subject matter background.

Students' orientation to learning

Our studies of the student learning experience alerted us to the need to better understand the student population in terms of more general motivational and behavioral indices. We therefore examined models of student orientation and motivation and their ability to predict success in courses (Ramsden, 1992). We began by asking students to describe their conceptualization of learning, learning strategies and educational expectations, in a questionnaire followed by interviews. Although students rated themselves as being well prepared for their courses, they did not rate their study skills as highly (Donald, 1995). Major differences were noticeable in how students in different programs spent their time, for example physics students spent more time studying and

doing homework and less time socializing and partying than students in the English literature course; English students reported spending as much time socializing as they did studying. Students exhibited a deep or meaning orientation to learning in their reasons for attending university, but they also attached importance to improving their chances of finding a job.

15. Students have a meaning orientation to learning and an achieving orientation in their reasons for attending university.

16. Students differ more in the way they spend their time than in their orientation to learning.

The effect of the learning climate on higher order learning

Our research had suggested that different learning contexts interacted with student characteristics to produce different learning effects, and specifically that some learning contexts challenged students to think more than others. We began offering academic seminars to first year university students in 1996, and as part of the evaluation of the project, asked them by means of questionnaires and interviews what emphasis they perceived was placed on higher order learning in the university and how their experience in the seminar compared to that in other courses. Large differences occurred between what students saw occurring in their seminar and in their other courses. In the seminars, students were challenged to think for themselves, but were neutral about their other courses providing challenge (Donald, McMillan-Davey & Denison, 1999).

They perceived that assessment of learning in the seminars tested their understanding rather than their ability to memorize, but in large classes, they were again neutral about whether their learning was adequately assessed. The differences between the climate in the seminars and their other courses extended to how the

students interacted with each other and with their professor. In the seminars, students more often helped each other in understanding difficult materials, got to know each other well, and were enthusiastic about participating in class activities. They reported that the professor spent more time talking informally with them before or after class, and was more willing to assist them outside of class. The difference in climate extended more generally to the enjoyment students felt in going to class and, more importantly, to the effort they put into what they did in class.

17. Students are challenged to think in seminars more than they are in large classes; assessment of their learning coincides with this emphasis.

18. Student cohesiveness and satisfaction are greater in seminars than in large classes; access to the instructor is greater.

Synthesis of research results

The results of these studies fall into three nested categories. At the most general level are findings about methods and lines of convergence across institutions and disciplines. These results describe variables in our context as faculty developers. At a more specific level, we can examine student learning and compare student experience. Nested within are the effects of differences in learning contexts, for example, in large and small classes. They serve as cautions and conditions that we need to take into consideration. These principles give us further insight into potential goals and conditions that we as faculty developers need to take into account, and the indicators of success we could use to ensure that learning is taking place.

Our context as faculty developers

Perhaps the most expected finding is that experts in a discipline agree most readily on the importance of fundamental principles or definitions in a course (Principle

5). Of some concern is the level of disagreement over abstract, general or conditional propositions in a course. This raises a fundamental curriculum issue: How variable is course content? How accountable are we for what we are teaching? In the past, academic freedom has protected course material; with the advent of electronic courses, how much attention needs to be paid to what constitutes a course?

A working model of thinking processes could be applied across disciplines (Principle 7). This supports the hypothesis that we have something in common in our attempt to develop students' thinking processes in the university. The preference for the development of inference and synthesis (Principle 8) further specifies an important outcome of postsecondary education. The thinking processes in the model could be used as criteria for course goals. Another important methodological finding was that participant observation in courses provided a very different perspective of student experience and learning than interview and visitation (Principle 13), reminding us that students have lives to live in addition to scholarly inclinations. How important other aspects of students' lives are, and the relative weight given to scholarly versus social activities and whether we can change this or use this knowledge, for example, in peer learning situations, merits further study.

Students

The findings on students are of two kinds, ones that describe them as they enter university, and others that describe interactions between them and the university milieu. Students come to us with a meaning orientation to learning and an achieving orientation: they want to learn and they want to succeed (Principle 15). Even so, there is a wide range in the way they spend their time (Principle 16). They appear to be prepared in terms of subject matter background but not in their learning strategies (Principle 14). We expect them to be able to think logically (Principle 9), but they choose the familiar and specific as important in their courses (Principle 6) and do not acquire a precise knowledge of the most important concepts in their courses (Principle 3).

They interpret the learning task as we describe it: if we emphasize knowledge, students will approach the learning task as if it is one of acquiring knowledge; if thinking, students will interpret the task as learning to think (Principle 12). These findings suggest that we need to provide students with clear expectations about what is important to learn and, more specifically, that they are expected to think. We also need to provide them with strategies for learning, including the amount of time it takes to learn, and with a learning climate where they are helped to learn. This will require emphasizing the structure of learning, orienting students to the new challenges that postsecondary education provides, and changing our instructional context.

Differences across learning contexts

The first major difference to be discovered across courses was the variation in the learning task, particularly in the number and kinds of concepts students are expected to learn, but also in how concepts are related in the course (Principles 1 & 2). If courses are not equivalent, then different standards must be assumed or assurance of equivalent value becomes an institutional priority. Differences in instructional methods reflect differences in the learning task (Principle 11). What we do not know is whether these are necessary or vicarious differences.

In the sciences and humanities, students' general ability is a stronger predictor of achievement in a course than more specific knowledge of concepts in the discipline; in the social sciences, concept knowledge is a better predictor (Principle 4). Does explanation of this difference lie in a new vocabulary, in the familiarity of terminology of more established disciplines in the general culture, or in the effect of prior educational exposure to these areas of study? Do the social sciences offer a truly different kind of education? Professors' expectations of entering students' ability to think were greater in social science fields such as psychology and education and in engineering than in other disciplines (Principle 10). Research shows that students make differential increases in inferential skills across the disciplines, favoring psychology (Lehman, Lempert, &

Nisbett, 1988; Nisbett, Fong, Lehman & Cheng, 1987; Ratcliff, 1988). This adds weight to the hypothesis that a different kind of education is occurring.

The kind of teaching method also affects learning. If students think in seminars more than they do in large classes, postsecondary institutions need to take account of the fact that smaller classes provide a better education (Principle 17). Assessment of student learning in the seminars coincides with this emphasis and leads to a more productive learning experience overall. Student cohesiveness and satisfaction are greater in seminars than in large classes, and access to the instructor is also greater (Principle 18). Seminars lead to communities of learning; large classes lead to anomie. What is our responsibility as faculty developers to our institutions with reference to the differential effects of learning contexts?

Indicators of success

These principles suggest indicators of success that represent major challenges for us as faculty developers. The similarities across contexts provide the first three indicators. The first is the appropriate content in a course. What is the conceptual structure of the course? Are fundamental principles and definitions being taught? Would other experts in the field agree with these principles? Are students learning the concepts and propositions? We begin our course design and teaching workshops with a day in which our professors create a concept map that will explain the major concepts in a course and their relationship. Throughout the week, they may adapt or alter this concept map so that it provides a conceptual road map for their students that is consistent with their instructional and evaluation methods.

In keeping with the general goal of postsecondary education to increase students' ability to think, the second indicator of success is whether students' have learned to think in a new way from their experience in the course. Accomplishing this goal will require explaining to students the difference between knowledge crunching and higher order learning, whether defined in terms of critical thinking, problem solving, or

expertise. We spend the second day of our course design and teaching workshop using models of thinking processes to establish higher order learning outcomes.

The third indicator is the extent to which students incorporate their learning in courses into their studies more generally and into their lives as scholars. Providing opportunities for students to extend their learning by means of extracurricular activities or field experiences is a program responsibility and requires extended planning by a curriculum committee. It also requires interaction at the campus level to ensure that these kinds of activities are supported by the campus as a whole. As faculty developers, it then becomes our responsibility to be proactive in establishing that kind of campus environment.

Responding to students' needs sets an additional series of indicators. We need to be clear in our expectations of what a successful student is, and enable our students to reach these goals. We need to provide students with strategies for learning, by means of introductory courses that include learning and study strategies appropriate to the discipline, by supplementary learning skills courses, by establishing peer study groups, and by means of advisors who can solve problems before they become crises.

The third set of indicators are more arcane and might appropriately be used to guide our own research. We need a better understanding of the variety of instructional goals and methods across disciplines and the extent to which they can be transferred. For example, would laboratories in social science courses lead to greater higher order learning? What methods and approaches best support higher order learning? If seminars challenge students to think in a manner that lectures do not, and eliminating lectures is unfeasible, how do we make lectures more like seminars?

These indicators of success broaden our responsibilities and require a proactive, one might say, diplomatic stance. But no longer the bearers of at times distasteful news to faculty, we can help them to be proactive in solving instructional problems and in aiding their students to have a meaningful learning experience.

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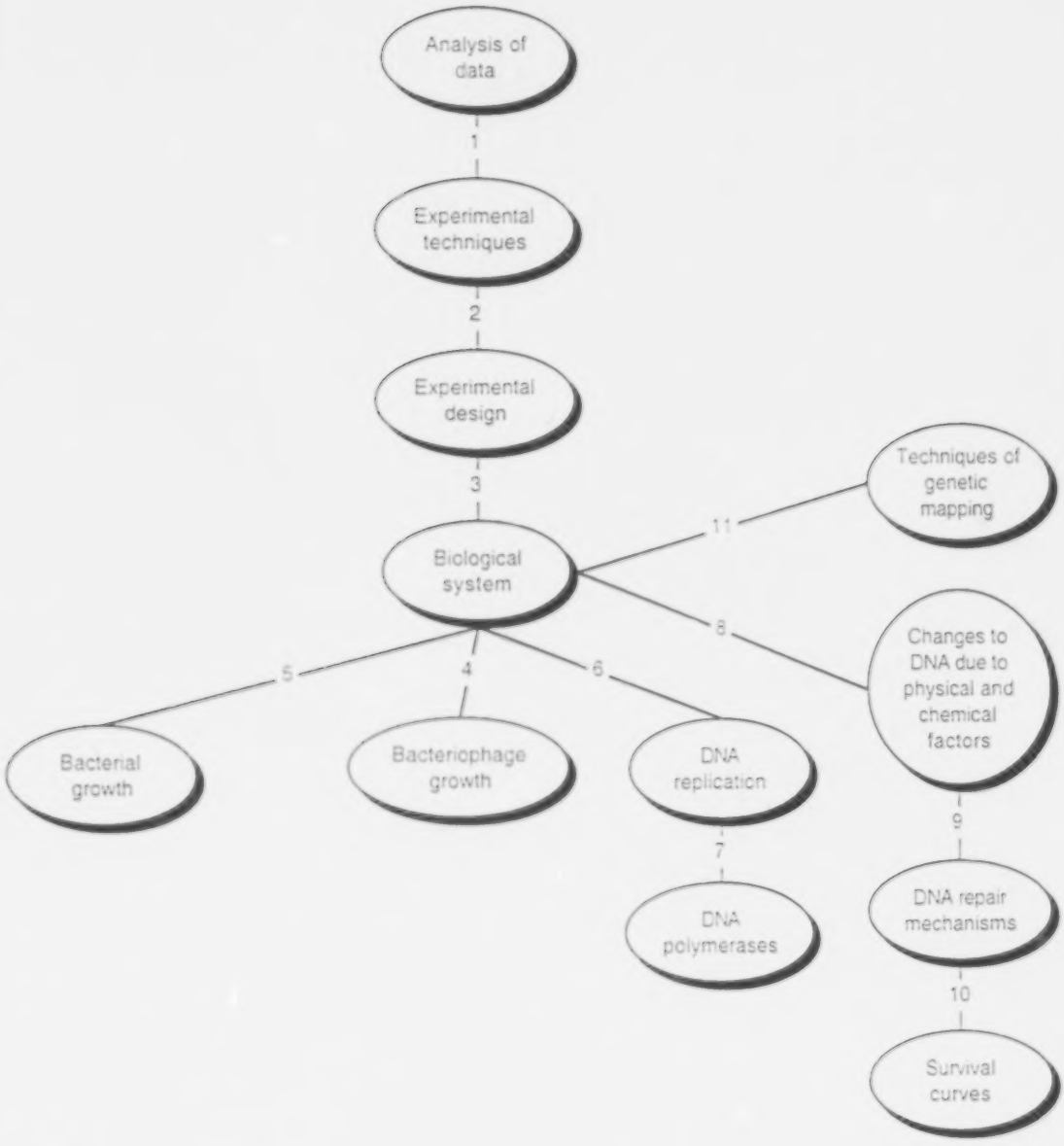

Figure 1. Initial key concepts in a microbiology course

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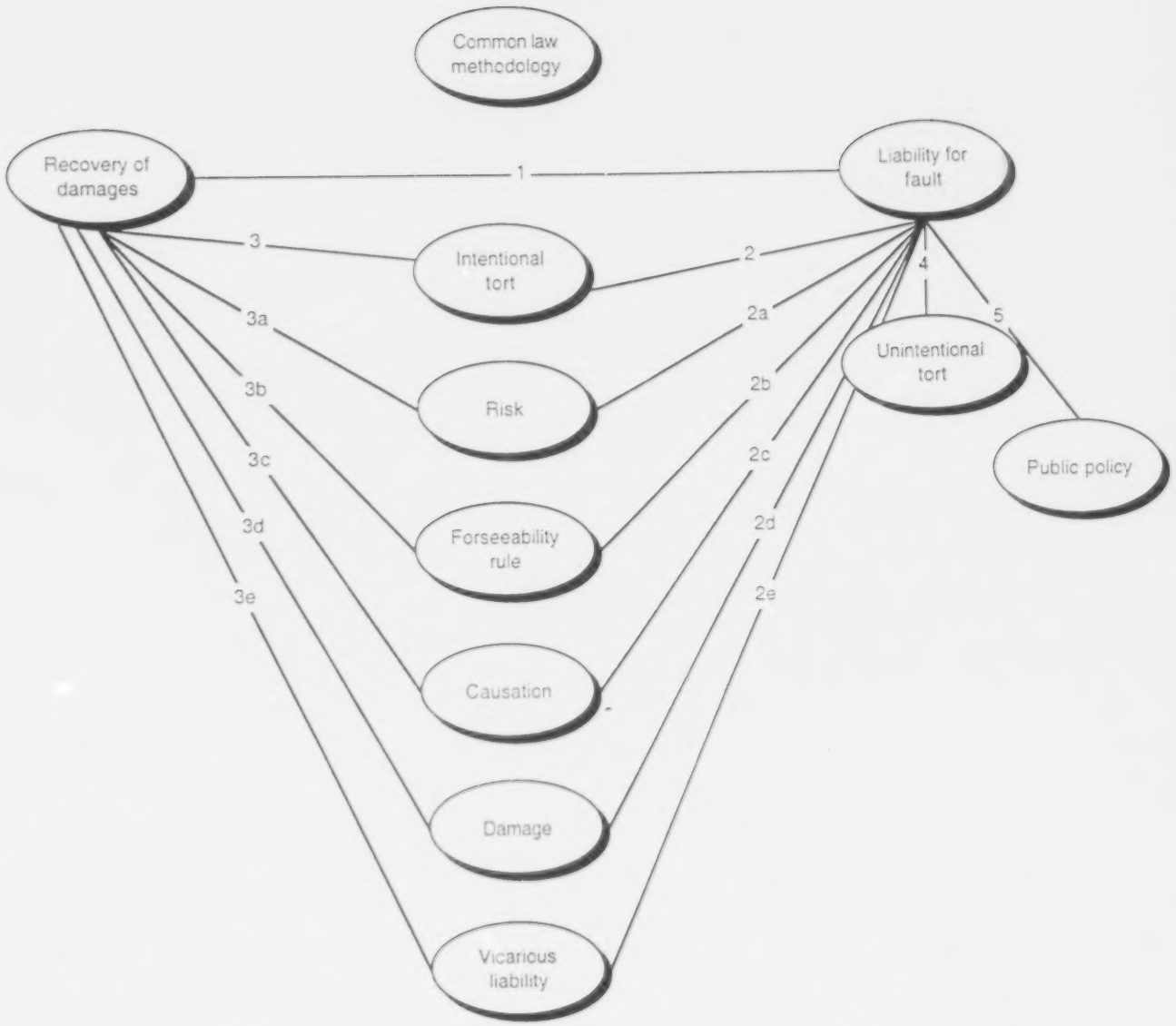

Figure 2. Key concepts in a law course on torts